REMARKS

As noted, Applicant has filed a request for continued examination. Claims 1-70 remain pending. Claim 16 has been cancelled. Reexamination and reconsideration is therefore requested.

Applicant would first like to thank the Examiner for the interview conducted on September 16, 2003. Applicant notes that the proposal for amending the claims discussed at the interview is presented herein. Applicant also appreciates the Examiner's indication that such proposal would be favorably considered by the Examiner.

Accordingly, claim 1 has been amended to recite the forming of a metallic glass coating on a substrate, the forming comprising forming a molten alloy and cooling said alloy to form a metallic glass coating, the forming comprising forming a successive build-up of metallic glass layers, with the resulting coating having a hardness of at least about 9.2 GPa, comprising an alloy containing fewer than 11 elements and wherein said alloy contains one or both of molybdenum and tungsten. The amendment to claim 1 is supported by the specification in its discussion, for example, of Fig. 6, which recites that layers 106 and 120 can be deposited as metallic glass and can remain in the metallic glass form during deposition of layers 120. In addition, reference is made to page 29, lines 1-4, which recites that the materials of the present invention having less than 11 elements, can form glass compositions, and page 23, lines 3-14, which discloses that DSC verified the formation of glass structure in the coating resulting from the build-up of layers of deposited powders. Attention is also directed to page 10, lines 6-7 which recite that the alloy may contain one or both of molybdenum and tungsten. Accordingly, no new matter has been entered

Claim 2 has been amended to recite the method of forming a hardened surface on a substrate comprising providing a substrate, forming a molten alloy and cooling said alloy to form a metallic glass coating on the substrate having a first hardness of at least about 9.2 GPa, the metallic glass

comprising fewer than 11 elements, and converting at least a portion of the metallic glass coating to a crystalline material having a nanocrystalline grain size and a second hardness of at least about 9.2 GPa. Support can be found at page 3, lines 19-22, and page 23, line 15 to page 24, line 4, which recites that the as sprayed coatings can be devitrified into a nanoscale structure by heating above the crystallization temperature. No new matter had been entered.

Dependent claims 3 – 4 and 6-8 have been made to depend upon claim 1.

Claim 13 has been amended to also recite the formation of a molten alloy and cooling said alloy to form a metallic glass coating on the substrate, the forming comprising a successive build-up of metallic glass layers. No new matter has been entered.

Claim 1 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,643,531 (Kim), or claim 1 of U.S. Patent No. 5,376,191. In addition, the Examiner has rejected claims 1-70 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 14-20 of U.S. Patent No. 6,258,185B1 (Branagan). The Examiner recognized that the hardness of at least 9.2 GPa was not taught by this prior art. Applicant responds as follows.

1. U.S. Patent No. 5,643,531

The '531 Patent to Kim is directed at a coating material and attention is directed to column 3, lines 31-41. There, Kim makes clear that as his alloy solidifies, right after being sprayed onto the surface to be coated, it forms a "homogenous single phase supersaturated solution." Kim then goes on to point out that this homogenous single phase supersaturated solution has an "unstable structure which can be transformed into the stable amorphous structure with high hardness and toughness under the friction and wear environments...". Therefore, unlike the present invention herein, Kim's alloys form an unstable structure and Kim relies upon friction and wear in order to convert such

unstable structure into a useful coating. Or, stated another way, Kim does not teach or suggest the formation of a metallic glass coating on the substrate by forming a molten alloy and cooling said alloy to form the metallic glass coating. Kim relies upon friction and wear.

Elaborating on this contrasting and limiting feature of Kim, and critically considering all of the examples in Kim, attention is first directed to Example 1 where the **as deposited** hardness is HRc 55-60.[1] Kim then goes on to emphasize that this is the value "before amorphous transformation". Therefore, Example 1 of Kim fails to teach or suggest forming a molten alloy and cooling to form a metallic glass, much less the hardness values of at least about 9.2 GPa.

Turning to Example 3 of Kim, once again, the as-deposited hardness is Hv 500-570. This corresponds to a HRc of about 50-54, which corresponds to a hardness value of 5.0 to 5.7 GPa. Again, this fails to teach or suggest forming a molten alloy and cooling to form a metallic glass, much less the hardness values of at least about 9.2 GPa.

Turning to Example 4 of Kim, once again, the as-deposited hardness was 50-52, which corresponds to a hardness value of 5.0 to 5.3 GPa. Again, this fails to teach or suggest forming a molten alloy and cooling to form a metallic glass, much less the hardness values of at least 9.2 GPa.

Turning to Example 5 of Kim, once again, the as deposited surface hardness is listed at HRc = 55, 45 and 65, which corresponds to a hardness value of 5.8, 4.4, and 8.2 GPA respectively. Again, this fails to teach or suggest forming a molten alloy and cooling to form a metallic glass, much less the hardness values of at least 9.2 GPa.

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[1] The designation of "HRc" by Kim is reference to a Rockwell Hardness value on the "c" scale. It is noted that Example 1 fails to achieve the hardness values claimed herein, as this would require a disclosure of at least HRc is 68, which corresponds to the claimed value of 9.2GPa. This is so since a HRc value of 68 corresponds to a Vickers Hardness of 940kg/m^2 which corresponds to a hardness value of 9.2GPa. For the convenience of the Examiner, a hardness conversion table is attached hereto.

Furthermore, it is noted that Kim does appear to provide, only **after** the coating is converted from its applied unstable form via frictional transformation, a surface hardness of HRc = 70 (10.6 GPa) (Example 1) and an Hv = 1200-1500 (Example 4) (11.8 to 14.7 GPa). However, once again, such hardness values are only obtained by the application of a second processing step that is obviated by the present invention which recites the forming of a molten alloy and cooling to form a metallic glass coating, the forming comprising the successive build-up of metallic glass layers, the metallic glass coating having a hardness of at least about 9.2 GPa.

Therefore, in sum, it is believed that claims 1-15 and 17-70 all recite subject matter that is not rendered obvious under 35 USC § 103 by U.S. Patent No. 5,643,531.

2. U.S. Patent No. 5,376,191 ('191)

In example 1 of the '191 patent, the hardness of the overlay was Hv = 480. This corresponds to a hardness of 4.7GPa. This is less than half of the hardness value recited in claim 1. In example 2, the hardness of the overlay was Hv = 870. This corresponds to a hardness of 8.5 GPa. In example 3, the hardness of the overlay was Hv = 550. This corresponds to a hardness of 5.4 GPa. In example 4, the hardness of the overlay was Hv = 685. This corresponds to a hardness of 6.7 GPa. Therefore, in all of these examples the hardness is **lower** than the claimed hardness of at least about 9.2 GPa and the alloys disclosed in such examples simply can not be said to teach or suggest a hardness of at least about 9.2 GPa. Indeed, if anything can be fairly stated about such alloys, they appear to teach away from the ability to achieve a hardness of anything more than 8.5 GPa.

It is noted that in example 5 of U.S. 5,376,191, and in a manner that was inconsistent with the much lower values reported above in examples 1-4, it was reported that the specific alloy Fe_{16}, Co_{16}, Ni_{20}, Cr_{10}, Zr_{10}, B_{14}, Si_{14} had a fusion temperature of 1080^0C and a Hv_{30} = 1430. This would correspond to a hardness value of about 13.7 GPa. However, as noted above, claim 1 has been

amended to recite that the subject alloy contains fewer than 11 elements and that the alloy contain one or both of molybdenum and tungsten. Notably, example 5 of the '191 patent fails to teach or suggest the use of molybdenum and tungsten in combination with all of the other aspects of claim 1 to provide a hardness of at least about 9.2 GPa, and it is therefore believed that claim 1 as amended herein is patentable over the '191 patent under the provisions of 35 USC 102 and/or 103.

Accordingly, for the reasons noted above, it is respectfully submitted that independent claim 1, and dependent claims 3-8, are now in condition for allowance.

Applicant next notes that independent claim 2 recites forming a molten alloy and cooling to form a metallic glass coating on a substrate having a first hardness of at least about 9.2 GPa, the metallic glass coating comprising fewer than 11 elements and converting at least a portion of the metallic glass coating to crystalline material having a nanocrystalline grain size and a second hardness of at least about 9.2 GPa. The U.S. '531 and '191 patents fail to teach or suggest such aspects of independent claim 2. Therefore, it is submitted that independent claim 2 and dependent claims 9-12 are also in condition for allowance.

Applicant also notes that independent claim 13 recites forming a molten alloy and cooling the alloy to form a metallic glass coating on the substrate, the forming comprising a successive build-up of metallic glass layers, wherein the alloy is selected from a group of alloys that are recited in claim 13 according to their individual formulae. Claim 13 also recites that the metallic glass coating has a hardness of at least about 9.2 GPa and the conversion of at least a portion of the metallic glass coating to crystalline material having a nanocrystalline grain size. The U.S. '531 and '191 patent fail to teach such aspects of independent claim 13. Therefore, it is submitted that independent claim 13 and dependent claims 14-15 and 17-70 are in condition for allowance.

Finally, it is recognized that claims 1-70 stand rejected under as an obviousness-type double

patenting rejection over claims 14-20 Branagan et al., U.S. Patent No. 6,258,185. Enclosed herein is a Terminal Disclaimer in compliance with 37 CFR 1.321(c) to overcome said rejection.

For the reasons discussed above, it is believed that claims 1- 15 and 17- 70 are allowable. Accordingly, applicant respectfully requests formal allowance of claims 1-15 and 17-70 in the Examiner's next action.

Respectfully submitted,

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Rockwell C	Vickers (kg/mm2)	Vickers (GPa)
80	1865	18.29
79	1787	17.52
78	1710	16.77
77	1633	16.01
76	1556	15.26
75	1478	14.49
74	1400	13.73
73	1323	12.97
72	1245	12.21
71	1160	11.38
70	1076	10.55
69	1004	9.85
68	940	9.22
67	900	8.83
66	865	8.48
65	832	8.16
64	800	7.85
63	772	7.57
62	746	7.32
61	720	7.06
60	697	6.84
59	674	6.61
58	653	6.40
57	633	6.21
56	613	6.01
55	595	5.83
54	577	5.66
53	560	5.49
52	544	5.33
51	528	5.18
50	513	5.03
49	498	4.88
48	484	4.75
47	471	4.62
46	458	4.49
45	446	4.37
44	434	4.26
43	423	4.15
42	412	4.04
41	402	3.94
40	392	3.84
39	382	3.75
38	372	3.65
37	363	3.56

36	354	3.47
35	345	3.38
34	336	3.30
33	327	3.21
32	318	3.12
31	310	3.04
30	302	2.96
29	294	2.88
28	286	2.80
27	279	2.74
26	272	2.67
25	266	2.61
24	260	2.55
23	254	2.49
22	248	2.43